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"Carpelloid stamens" in *Lotus sp.*

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Abstract

The anatomy and cytology of flower buds in which one or two stamens underwent modifications of various degree, termed in the teratological terminology "carpelloid stamens" were analysed in *Lotus*. It is presumed that these disturbances were due to the hybrid character of the studied plants.

INTRODUCTION

A number of authors stress the usefulness of observations of flower abnormalities in studies on the process of flower differentiation. Meyer (1966) collected data since 1790 (Goethe's essay on metamorphosis). The genus *Lotus* is mentioned in this publication among the species of *Leguminosae*, and the abnormality noted in these plants was classified as petaloidy of the stamens or of petal-resembling formations instead of stamens. In the present paper "carpelloid stamens" (according to the terminology of Meyer) so far not reported in *Lotus* are described.

MATERIAL AND METHODS

Lotus flower buds (probably *Lotus corniculatus* L.) from wild plants growing on an experimental plot of the Institute of Plant Genetics in Poznań in the years 1975 and 1976 were fixed. The buds were longitudinally cut with the use of the paraffin technique and stained with iron haematoxylin and counterstained with Fast green. In 1975 among the preparations inspected 25 per cent and in 1976 — 18 per cent showed atypical buds. In the period 1965-1969 two species of *Lotus* grew on the field of the Institute among other plants: *L. corniculatus* L. and *L. uliginosus* Schk. Both these species included representatives of numerous populations collected all over the territory of Poland. Seeds of these

plants had been collected by Prof. T. Kazimierski and part of them was sown in the same year on the Institute plot. In 1969 the field was ploughed. *Lotus* is a perennial plant with dehiscent pods. It readily forms clones and the particular species of this genus intercross. The analysed plants with abnormal flowers may thus have been hybrids of *L. corniculatus* x *L. uliginosus* or interpopulation hybrids of *L. corniculatus*.

RESULTS

In atypical buds among the ten stamens one or two were changed to carpelloid ones. The diversity of various type transformations was high — from stamens with growing out naked ovules at the base of the head, over pistilloid forms, to pistils growing at the site of stamens (Photos 1, 2). In the stamens with naked ovules normally developed pollen grains were seen, whereas in only few ovules could megasporocytes be observed in the stage of prophase I. These megasporocytes were, however, deformed and stained poorly, this indicating that the process of meiosis did not occur normally in them. Anatomical and cytological analysis of the pistilloid formations — "carpelloid stamens" showed that they produced ovules and pollen sacs (Photos 3a, 3b, 3c and 4-6). However, the megasporocytes in the ovules and microsporocytes or pollen grains in the pollen sacs of the "carpelloid stamens" degenerated.

In the unmodified normal anthers of flowers with "carpelloid stamens" two-celled pollen grains formed, and in the normal pistils of these flowers both normal meiosis and degenerated process in division I or II were observed in the ovules. As a result part of the ovules in the normal pistils developed normally so that in older ovules monospore embryo sacs of *Polygonum* type were observed. The development of ovules in the "carpelloid stamens" was always retarded as compared with that in normal pistils of the same bud, for instance in the ovules of a normal pistil prophases I were noted, whereas in the "carpelloid stamens" there were only undifferentiated bulges of ovules, in another bud they were in the tetrad stage and in the "carpelloid stamen" hardly in prophase I. They were observed only up to prophase I, therefore it is difficult to decide whether further development occured normally. In some "carpelloid stamens" ovules were absent.

DISCUSSION

In flower buds with abnormalities part of the ovules in normal pistils and pollen grains in normal anthers and anthers with naked ovules developed normally as described by H a n s e n (1953) in *Lotus corniculatus* L. Degenerating ovules observed in normal pistils in buds with abnor-

Plate I

Photo 1. Longitudinal section of "carpelloid stamen" in *Lotus* with outgrowing naked ovule at base of head (× 134)

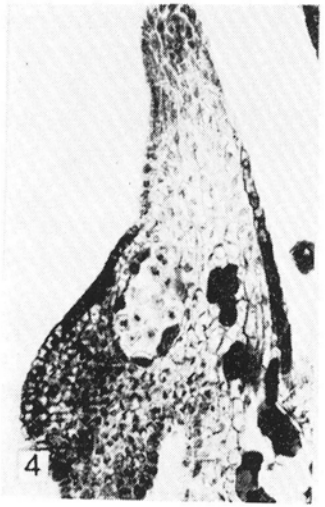
Photo 2. Longitudinal section of young *Lotus* bud; the "carpelloid stamen" is as long as the stamens of the upper whorl (× 53)

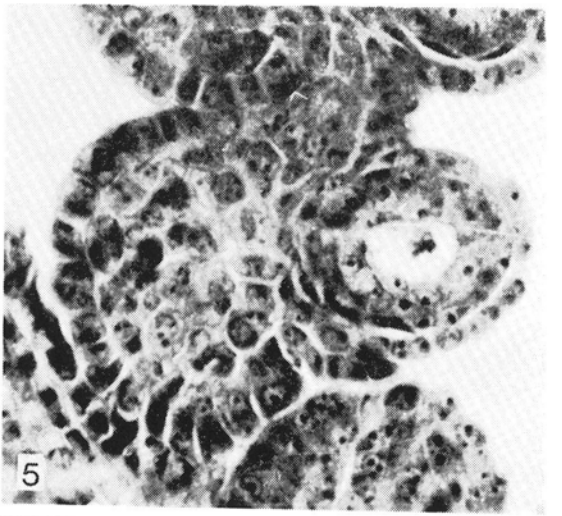
Photo 3a. Longitudinal section of *Lotus* bud; on the right from pistil "carpelloid stamen" which is half pistil and half stamen (× 37)

Photo 3b. Cross section from pistil-like side of the same "carpelloid stamen" as in Photo 3a (× 37)

Photo 3c. Cross section from stamen-like side of the same "carpelloid stamen" as in Photo 3a (× 37)

Plate III





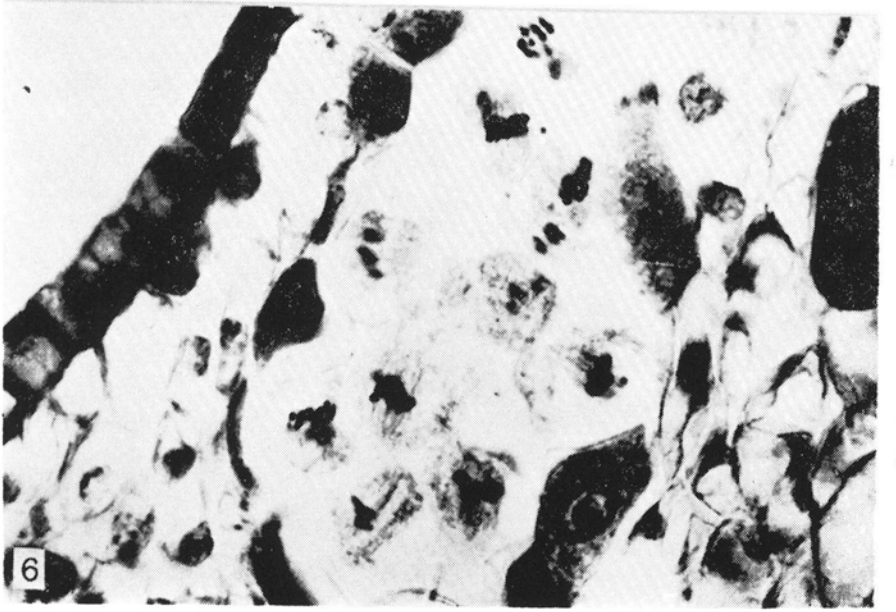


Photo 4. Fragment of "carpelloid stamen" from Photo 3a ending in a style and stigma: pollen sac is visible at base of style (× 100)

Photo 5. Ovules of "carpelloid stamen" from Photo 3b (× 260)

Photo 6. Fragment of pollen sac from Photo 4 with microsporocytes surrounded with tapetum layer, late metaphase I (× 550)

malities correspond to the high percentage of degenerating ovules noted by Burbar (1958) in *Lotus corniculatus*.

Natural and experimental hybrids of *L. corniculatus* x *L. uliginosus* are known (Grant 1965, see Ref.). Recently the possibility of crosses of *L. corniculatus* x *L. uliginosus* has been confirmed by Barcikowska (1974, 1976).

The abnormalities in flower structure of distant hybrids and mutants are well known (Meyer 1966). Less frequently described are abnormalities of flower structure due to intraspecific crosses (e.g. Jaranowski 1972). The here described diversity of "carpelloid stamens" is also found in other species: pea (Monti and Devreux 1969), tobacco (Hicks et al. 1977), tomato (Sawhney and Greyson 1973a) and blackberry (Shealy and Herr 1973). It results from the studies of Monti and Devreux (1969), Fisher (1972) and Sawhney and Greyson (1973a) that the influence of external conditions is considerable on the transformation of stamens.

The occurrence of abnormalities in the formation of flowers both in hybrids and mutants may be explained by the fact that, as a consequence of genetic changes arising in these forms, disturbances appear in the production of endogenous hormones which are essential for flower formation (Lodkina 1977). Earlier studies of Hicks (1975), Sawhney and Greyson (1973b) and Sawhney (1974) support this hypothesis. Comparative studies of plants with normal flowers and those showing abnormalities may be a useful tool for understanding the genetic control of some development processes (Sawhney and Greyson 1973a).

Tomes (1979) and Swanson and Tomes (1980) demonstrated in *Lotus corniculatus* an ability to micropropagation. This ability and the readiness of forming clones will make possible investigation of identical plants with identical flower abnormalities under various controlled conditions of the environment. This will allow to establish the influence of external conditions on definite pistil transformations in Lotus.

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Owocolistkowatość pręcików komonicy (Lotus sp.)

Streszczenie

Analizowano anatomię i cytologię pąków komonicy, w których w miejscu jednego lub dwu pręcików wyrastały przekształcone utwory, w których ujawniły się w różnym nasileniu cechy żeńskie. W literaturze teratologicznej tego typu zaburzenia określa się jako owocolistkowatość pręcików. Przekształcone pręciki najczęściej nie wytwarzały prawidłowych gamet, natomiast w pozostałych normalnych pręcikach powstawały dwukomórkowe ziarna pyłku; również w normalnych słupkach tych pąków część zalążków rozwijała się prawidłowo. Przyjmuje się, że przyczyną opisanych zaburzeń był mieszańcowy charakter badanych roślin. Opisane zjawiska rozważa się na tle literatury.